

## IF YOU MOVE...

Please contact us with your new address and phone number so that we can keep you up to date on all of our research findings. You can send your change of address and/or phone number to the attention of the Beryllium Research Program NIOSH, 1095 Willowdale Road MS H2800, Morgantown, WV 26505, or call us at 1-800-447-8305 and we will be glad to take your new address and/or phone information.

## FOR FURTHER INFORMATION...

If you would like further information on any of the topics in this newsletter or if you have questions regarding our Beryllium Research Program please contact us at the Beryllium Research Program NIOSH, 1095 Willowdale Road MS H2800, Morgantown, WV 26505, or call us at 1-800-447-8305.

**WEB:** <http://www.cdc.gov/niosh> **PHONE:** 1-800-447-8305 **FAX:** 1-304-285-5820

Department of Health and Human Services  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health  
1095 Willowdale Road M/S H2800  
Morgantown, WV 26505-2888



**Delivering on the Nation's Promise:**  
Safety and health at work for all people  
through research and prevention

## Welcome To Our Third Newsletter

This issue provides an update of the ongoing beryllium research findings at the National Institute for Occupational Safety and Health (NIOSH). **If you have questions about any of this information, please call 1-800-447-8305.**

Christine Schuler, Ph.D.  
Beryllium Program Leader  
Field Studies Branch, NIOSH

## INTRODUCTION

In the early 1990s, workers at two Brush Wellman Inc. (BWI) plants were surveyed to study the relationship between beryllium exposure (both types of work performed and airborne levels) and beryllium sensitization and chronic beryllium disease (CBD). These workplace studies were completed in 1992 at the Tucson, AZ ceramics plant and in 1993-1994 at the Elmore, OH production facility. Since 1998, NIOSH and BWI have worked together on a series of surveys at the Tucson ceramics plant, Elmore production facility, Reading, PA finishing facility, and three distribution centers. NIOSH also surveyed workers from the 1992-1994 and 1998-2000 surveys at Tucson, Elmore, and Reading who left employment.

Findings from this research have told us that:

- 1) Engineering controls designed to reduce airborne exposure to beryllium at higher-risk work processes did not do enough to reduce levels of sensitization and CBD.
- 2) Beryllium sensitization and CBD can occur even in conditions of low beryllium exposure.
- 3) Risk of sensitization and CBD is underestimated when workforces are surveyed only once.

As a result, BWI developed a comprehensive enhanced preventive program for its three main plants: Tucson, Elmore, and Reading. This program includes additional engineering controls, administrative controls (for example, to keep beryllium contained near the work processes and out of clean areas such as the locker room and your cars/houses), and expanded use of personal protective equipment (such as respirators and protection of the skin with clothing and gloves).

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## Tucson's Enhanced Preventive Program Reduces Beryllium Sensitization among New Workers

A 1998 survey showed that nearly 10% of workers hired at the Tucson plant between 1993 and 1998 were sensitized to beryllium. As a result, the plant enhanced its existing preventive program, introducing controls like air showers, use of powered air-purifying respirators (PAPRs), and skin protection (pictured below). Researchers at NIOSH recently found that this enhanced preventive program successfully reduced beryllium sensitization among new workers hired since 2000. The researchers compared beryllium lymphocyte proliferation test (BeLPT) results of workers hired at Tucson from 2000 to 2004 with those of workers

hired from 1993 to 1998 and tested in 1998. While 8.7% (6 of 69) of the 1993-1998 workers had sensitization, just 1% (1 of 97) of the 2000-2004 workers had sensitization. This decrease in sensitization was probably not related to a change



in air levels of beryllium, as overall air levels were found to be similar for the two time periods. Instead, other components of the enhanced preventive program, including full time respiratory protection, improved housekeeping and reduced contamination of work clothing and skin, were likely responsible. For this study, most of the 2000-2004 workers had worked for less than 2 years at the time of their final BeLPT, so the researchers were unable to study the long-term impact of the enhanced preventive program on sensitization and CBD. NIOSH encourages workers at the Tucson, Reading and Elmore plants to participate

in follow-up studies to help answer important questions about whether the enhanced preventive program works in the long-term.

## What can be learned from genetic research in the laboratory?

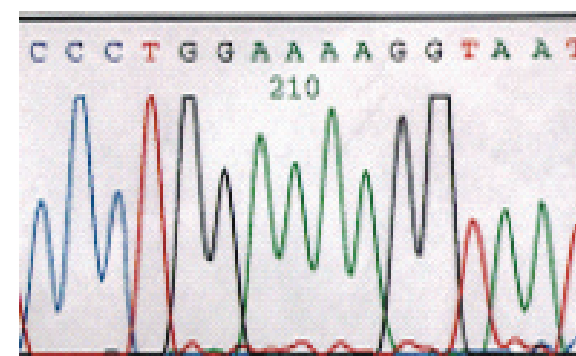
Some people are more susceptible to the effects of beryllium exposure than others. We have learned through our work together with BWI and the work of others that this is due, at least in part, to an association with HLA-DPB1Glu69-a genetic marker called Glu 69 gene. In addition, there are many questions that could be investigated if an "animal model" for CBD was available. To fill this research gap a "transgenic mouse" model has been developed in partnership with Dr. Eddy Rubin at the Lawrence Berkeley National Laboratories in Berkeley, CA. This was done by merging specific human genes (HLA-DPB1) with mouse DNA.

Three strains of transgenic mice that contain human HLA-DPB1 genetic material have been developed: one with a high risk Glu69 gene, one with a moderate risk Glu69 gene, and one with a low risk non-Glu69 gene. These genes were selected based on previous research by NIOSH scientists and others that showed different levels of risk for beryllium disease. The first step is to prove that these transgenic mouse strains are actually a model for CBD. The mice will then be exposed to different forms of beryllium (for example, beryllium oxide, beryllium metal, beryllium alloys, and beryllium salts) at different doses. We can also compare the effects of skin versus lung exposures.

This research may benefit beryllium workers by enabling us to better understand the genetic basis for risk of beryllium sensitization and CBD, and which forms of beryllium exposure are most likely to cause sensitization. It may also help us to understand which personal protective equipment to use under different exposure conditions.

# DNA

Chemical Code (4 letters)



<http://www.pbs.org/wnet/dna/episode3/index.html#>

### Does skin play a part in sensitization?

Significant reduction in beryllium air levels below regulatory levels (2 micrograms per cubic meter of air [ $\mu\text{g}/\text{m}^3$ ]) has failed to prevent beryllium sensitization. The inability to protect workers from becoming sensitized by reducing the amount of beryllium in air alone has led to the idea that sensitization may occur through the skin. The ability of certain chemical forms of beryllium to cause sensitization via the skin has been recognized for more than 50 years.

A new NIOSH project at BWI production facilities will be looking at levels of beryllium skin exposure occurring



among workers in relationship to levels of beryllium in the air and on surfaces. We will ask participating workers to wear thin cotton outer gloves over their nitrile or latex gloves and a personal lapel air sampler (pictured below). These cotton gloves will collect particles that would have gotten on skin, if nitrile gloves were not worn. We will also be taking wipe samples from surfaces workers touched while wearing the cotton gloves. These samples will help us to estimate relative skin exposures and exposures from beryllium in the air from workers in facilities involved in specific processes, some that are associated with higher risk of beryllium sensitization and disease, and some that are not. This study may be useful to workers exposed to beryllium and other sensitizing agents and to workers, management, and policy makers in the other metal industries, including hard metal, aluminum refining and smelting, recycling, and nanotechnology.

### Reduced Beryllium Sensitization among New Workers at Reading

Despite relatively low levels of beryllium in the air, the 2000 survey in the Reading, PA facility found that 7% of workers were identified as beryllium sensitized and 4% of workers had CBD. Risk was associated with work in and around the bulk pickle and annealing process. BWI began the current prevention program at Reading after seeing the results from the survey. NIOSH researchers are looking at the effectiveness of the prevention program in the Reading plant by comparing workers who participated in the 2000 survey (legacy workers) and those hired after the start of the prevention program (program workers).

While 11.6% (5 out of 43) of the legacy workers were shown to be sensitized, just 2.4% (2 out of 82) program workers were sensitized. Comparing these two groups

showed us that people hired after the beginning of the prevention program had approximately 1/5 the risk of becoming sensitized than people hired before the prevention program.

Part of the prevention program included enclosing the bulk pickle and annealing processes to create the restricted access zone (RAZ)(pictured below). The two program workers identified as sensitized were both hired before the RAZ enclosure. Sensitization has not been detected in workers hired after the RAZ enclosure. This tells us that the preventive program seems to be working. However, the situations in Reading and Tucson are similar in that most of the program workers in Reading had worked for less than 2 years at the time of their final BeLPT, so we still need to study the long-term impact of the preventive program on sensitization and CBD. Again, NIOSH hopes workers at the Reading, Elmore, and Tucson plants will participate in our upcoming study, which will help us examine whether the preventive program works in the long-run. The new study is described in more detail in the next section.



## What's Next

The NIOSH beryllium research team (pictured below) has received funding to continue its work through 2010. The four new research projects are explained below.

### Is the preventive program working at each of the plants?

Recent short-term evidence suggests that BWI's preventive program at the Tucson and Reading plants has successfully reduced the occurrence of new cases of beryllium sensitization. However, only two plants have been studied so far, workers have only been tested for sensitization while they were employed, and the program must be studied for a longer period of time to see whether sensitization has been prevented or just delayed and whether CBD has been reduced.

A new round of surveys is scheduled for Tucson, Elmore, and Reading beginning in 2008 to evaluate the effectiveness of the preventive program. NIOSH staff will travel to each of the three plants throughout 2008 and early 2009 to meet with employees to provide more detail about the upcoming surveys and answer questions. Participation in these surveys is open to all current and former workers hired after these dates: January 1, 2000 in Tucson, February 1, 2000 in Elmore, and June 1, 2000 in Reading. NIOSH research staff will collect questionnaire data and all study participants will be offered a BeLPT. The information collected during this study will help provide a more complete description of the effectiveness of the preventive program in reducing sensitization and CBD. We hope that everyone who is eligible will participate in this important research aimed at preventing beryllium sensitization and CBD.



**Seated:** Ann Hubbs, Marcia Stanton, Abbas Virji, Greg Day  
**Standing:** Erin McCanlies, Kristin Cummings, Aleks Stefaniak, Christine Schuler, Carrie Thomas, Rachel Bailey, Ainsley Weston

## Do different forms of beryllium affect health outcomes?

Beryllium is produced in different forms, including beryllium metal, beryllium oxide, beryllium alloys, and beryllium salts. Each different form has special properties that make it useful for specific applications. For example, beryllium metal is transparent to x-rays, which makes it a useful material for windows in medical x-ray equipment; beryllium oxide has good electrical resistivity and heat conductivity, which make it useful for electronic circuit boards even in high temperature applications; and beryllium alloys may possess high strength, springiness, and corrosion resistance, making them useful for switches and springs.

Substantial decreases in total airborne beryllium mass concentration exposure levels do not prevent or predict the risk of beryllium-associated illnesses. NIOSH researchers think that beryllium particle

size, chemistry, and surface area and how the particles dissolve in the body may be important in determining how the body responds to beryllium.

NIOSH researchers have collected particle samples from 25 work processes at four BWI facilities that represent all phases of beryllium extraction (Delta, UT), primary beryllium manufacturing (Elmore, OH), ceramics forming and machining (Tucson, AZ), and alloy finishing (Reading, PA). Particle samples were collected from work processes that may or may not be associated with increased risk of beryllium sensitization and CBD. This project will measure the size, chemistry, and surface area of beryllium particles. As part of this project, researchers plan to measure and compare how fast beryllium dissolves from particles collected from the 25 different processes

using artificial lung fluids and skin sweat in the laboratory. Upon completion of this study, we hope to know more about beryllium disease and help to reduce the exposure risk of beryllium sensitization and CBD among the estimated one million workers in the United States who have ever been exposed to beryllium.

